Spatial-Temporal Analysis of Land Surface Temperature and Vegetation Dynamics in Nintavur, Sri Lanka

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Abstract

Climate change and rapid urbanization have significantly altered local microclimates, particularly in coastal regions such as Nintavur, Sri Lanka. Land Surface Temperature (LST) and the Normalized Difference Vegetation Index (NDVI) are crucial indicators in assessing these environmental transformations. This study aims to investigate the spatial and temporal variations in LST and NDVI between 2014 and 2024 to understand land cover changes and their environmental impacts in the Nintavur area. The study utilised Landsat 8 Operational Land Imager (OLI) and Thermal Infrared Sensor (TIRS) data for 2014, and Landsat 9 imagery for 2024, were acquired from the USGS Earth Explorer platform. Standard radiometric and atmospheric corrections were applied to the imagery using ArcGIS 10.8. Land Surface Temperature (LST) was calculated by converting thermal band digital numbers (DN) to radiance, followed by brightness temperature and emissivity correction methods. The Normalized Difference Vegetation Index (NDVI) was derived from the red and near-infrared (NIR) bands. High and low values of LST and NDVI were extracted from the processed raster layers. Spatial analysis, including heat mapping and change detection, was performed to compare the patterns between 2014 and 2024, focusing on urbanizing zones. The analysis revealed a substantial increase in Land Surface Temperature (LST) over the ten-year period. In 2014, LST ranged from 22.91°C (low) to 34.78°C (high), whereas in 2024, it escalated to a range of 27.32°C (low) to 41.72°C (high), indicating an overall temperature rise of approximately 7°C in maximum LST. Concurrently, NDVI values exhibited slight improvement in vegetative density at the upper range, increasing from 0.5128 in 2014 to 0.5319 in 2024; however, the minimum NDVI declined from 0.0078 to –0.1166, suggesting localized vegetation loss and potential soil or built-up surface exposure. Spatial analysis identified a strong inverse correlation between LST and NDVI, particularly in rapidly urbanizing zones where vegetative cover loss was most pronounced. The urban fringe areas of Nintavur exhibited the highest thermal intensification, signalling the emergence of an urban heat island (UHI) effect. These findings demonstrate that vegetation degradation and land cover changes

have directly contributed to the spatial amplification of surface temperatures over the study period. The findings reveal a notable increase in LST and a decline in vegetative health in key parts of Nintavur over the past decade, primarily due to urban expansion. Urgent interventions, such as green infrastructure development, reforestation, and integrated urban planning, are recommended to mitigate UHI effects and restore ecological balance. This study provides novel insights into micro-regional climate-vegetation interactions in Nintavur using a decade-long geospatial analysis, reinforcing the importance of satellite-based environmental monitoring in local climate assessments.

Keywords: LST, NDVI, Urban heat island, remote sensing, Nintavur